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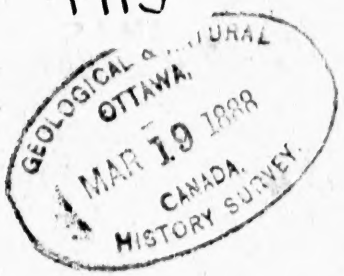

SABLE ISLAND,

Its probable Origin and Submergence.

BY SIMON D. MACDONALD, F. G. S.

(Read before the Institute of Natural Science, January 11, 1886.)

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ART. III.—SABLE ISLAND, NO. 3.—ITS PROBABLE ORIGIN AND SUBMERGENCE.—BY SIMON D. MACDONALD, F. G. S.

(*Read January* 11, 1886.)

Mr. President and Gentlemen,—

I MAKE no apology for occupying your attention in discussing for the third time Sable Island, and its attendant phenomena.

Independent of the call this Island makes to a rich and varied field for scientific research, there comes a deeper voice across the mad tumult of its breakers, and amid the storms that appear to vent their fury in its vicinity, asking in the interests of humanity for a wider knowledge of the causes which have associated such horrors with its very name.

In addition to this, the proximity of this fatal Island to our shore,—the unfavorable reputation it has already given to our coast and its approaches, and the certainty of its complete submergence at no distant day, with the probability of its becoming a still greater dread to the mariner,—makes this Island a proper subject of investigation for this Society.

It comes within its province to observe and record for the benefit of not only the present but for the many future investigators, who will doubtless value everything of information left by us, and scan with eager glance in coming days the varied resume of facts we have collected, or left for them to theorize and debate upon.

In my first paper I brought to your notice the Island generally, its history, natural features, wrecks, etc.; and also showed that from its geographical position situated at the interlacing of three of the most remarkable currents which encircle it with those swift eddies so fraught with destruction, whilst the atmospheric influences borne to it on the bosom of those dissimilar and opposing currents, surround it with conditions not found elsewhere, and afford for meteorological purposes a point unsurpassed in the North Atlantic.

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In my second paper I called your attention to the vicissitudes this island had undergone from storm and current which, according to Admiralty surveys, had within 80 years reduced its area from 40 miles in length and 2¼ miles in breadth to 22 miles in length and less than 1 mile in breadth, and its height from 200 feet to 80 feet, materially altering its outline and position.

I will now endeavor to trace its origin, its relation to that vast sand accumulation known as off shore banks, and also the causes now at work hastening its destruction or submergence.

Of course any attempt at an explanation of its origin must be based upon the assumption that it is the result of natural agencies, in other words that it is not a mere huge sand bank thrown up by some freak of nature, as it might appear to a casual observer, but that the forces that rolled each grain of sand against its fellow until this immense accumulation arose as an island from its ocean bed, are governed by a law as fixed and unalterable as that which holds the planets in their orbits.

In seeking for its origin among others two theories are prominent. 1st, that it is the result of causes now visible and subject to investigation, as in the case of material being transported by icebergs. 2nd, that it is the remains of a former age, now undergoing geological changes yet unfinished.

Before us we have a chart showing off shore banks, and another showing their relative submergence, which I have compiled from latest surveys.

Beginning at the eastern extremity of this remarkable formation we have what is known as the great bank, 240 miles E. and W., and 294 miles N. and S., an area equal to the whole island of Newfoundland. West from this we have the Quero bank, 120 miles in length; north of this again is the Canso bank, 60 miles in length; west from Quero, 12 miles distant, we have the Sable Island bank, 200 miles in length and 90 miles in breadth. On this bank we have a narrow thread-like elevation above the surface which is Sable Island proper. North of this, separated by a narrow channel, is what is known as the middle ground, 35 miles in length. West from this is Sambro, 12 miles in length; then La Have bank 32 miles E. and W.; then the Roseway bank,

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16 miles long; westward again we have the Great George's bank, with shoals reaching the surface; a little further westward we reach the shoals of Nantucket; the whole forming an immense deposit, following the curvation of the coast.

We will now turn from geological formation to the course of those great currents which divide and control ocean forces.

By glancing at Maury's physical chart it will be seen that the Gulf Stream, after discharging its heated water through the channel formed by the coast of Florida on the one side and Cuba and the Bahamas on the other, follows the trend of the American coast northward until approaching the shoals of Nantucket where it swerves to the N. E., passing south of Sable Island to the tail of the great bank of Newfoundland, and then stretching over to Europe in a due east direction.

In opposition to this we have the cold ice-laden current of the north, one portion of which after leaving the Arctic ocean, passes southward along the eastern coast of Greenland where, being joined by another branch coming from Baffin's Bay and Davis Strait, it passes along the coasts of Labrador and Newfoundland to the great banks, where it is met by the northern edge of the Gulf Stream.

At this point a division of the polar current takes place. One portion, from its greater density, sinks below the warm current of the Gulf Stream, and continues its course southward as a submarine current.

The other portion of the polar current, where it impinges on the Gulf Stream at the Great bank, becomes deflected to the westward partially by contact with the Great bank, and in its course its northern edge sweeps around Cape Race into St. Mary's and the other bays north until losing its momentum it falls back and joins the main body of the current. This portion, sweeping around and into those bays, is commonly called the indraught by mariners, and to it being accelerated by certain storms may be attributed the loss of the Cedar Grove at Canso and the Cromwell boats and the Hanoverian at Cape Race.

The southern edge interlaces the Gulf Stream and carries western bound vessels at such a rate as frequently leads mariners to

miscalculate their position with reference to this Island, to which fact is attributable many of the wrecks.

Capt. Darby, a former Superintendent of the Island, in a letter to Blunt's coast pilot, with regard to the strength of this polar current, says:

"The most of the wrecks occurring here arise from error in longitude. I have known vessels from Europe that had not made an error of half a degree in their longitude until they came to the banks of Newfoundland, and from there in moderate weather and light winds have made errors from 60 to 100 miles."

It is difficult to understand how that the commanders of vessels making voyages to and from this country for so many years, should be apparently so ignorant of the strength of these currents, unless as it would seem they have periods of comparative quiescence and activity.

Then again we have a third current, a portion of the polar current, which, becoming detached at the southern end of Labrador and sweeping through the Strait of Belle Isle, is joined by the vast flow of the St. Lawrence, and forms what is known as the Gulf of St. Lawrence current. This combined current skirts the east side of Cape Breton, passes south and strikes obliquely in the vicinity of Sable Island, that portion of the polar current which is deflected westward by contact with the Banks of Newfoundland.

We will refer to this oblique current again.—

From ocean currents we will consider another of nature's great forces shown in the transporting power of ice.

This great polar current skirting the coast of Greenland and Labrador is constantly bringing its great ice rafts laden with rock, sand and gravel from the north to the margin of the Great Bank, where meeting the warm waters of the Gulf Stream they deposit their burdens, the finer portion of which being carried forward by the current is distributed along the line of the impinging stream.

To learn something of this transporting power we will refer to the evidence of those Arctic navigators who have minutely chronicled their observations.

Capt. Scoresby, who reconnoitered the foot of the great glacier of Spitzbergen, counted at one time upwards of 500 icebergs starting out on their course southward, many of which were laden with thousands of tons of sand, mud and gravel.

Capt. Wilkes, of the United States exploring expedition, landed upon an upturned iceberg, supposing it to be an island. Upon it he found huge boulders of basalt and sandstone embedded in mud, sand and gravel, the whole forming an ice conglomerate.

Sir John Ross mentions an incident of an iceberg capsizing in lat. 74°, bringing up a portion of the bottom 100 feet above the surface, so that it was for the moment supposed to be an island not previously seen.

In addition to the masses of rock, sand, etc., accumulated on the surface of the glacier from the adjoining cliff, and the mud and sedimentary matter scooped from the sea bottom by upturned icebergs, is to be added the effect of land ice, as observed by Kane and others, where the shores of the Arctic in a similar manner to ground ice forms in more than a hundred feet of water, raising from the bottom an enormous amount of material. On the breaking up of the ice those floes are carried off by the current southward to be discharged at the great dumping grounds of Newfoundland.

Commander White, of the U. S. Navy, in his Arctic voyages also relates seeing the birth of an iceberg which cracked from the glacier with a loud report, and after a summersault in 180 fathoms of water appeared with an enormous cliff of granite embedded in its surface, which it had carried from the adjoining bluff.

It is obvious that with this transporting process, carried forward for a long period of time, we may look here for deposits on a colossal scale, and account for not only the great Bank of Newfoundland, but the whole series of Banks, of which Sable Island is the apex.

It may be thought by some that while this process may be deemed sufficient to account for the formation of the great Bank, we must look to some other source for the presence of the western Banks.

Assuming this to be the force that created the great Bank, there must have been a time when this Bank had not reached its present dimensions, and indeed was only in the first stages of formation, consequently the unimpeded Gulf Stream would press the shore more closely, crowding the western bound currents and thus by narrowing its channel increase its velocity. Add to this the fact that the polar current, not being divided as now by the great Bank, would have a more decided flow, and would carry its ice raft further westward. Thus the dumping of material would take place at the western extremity as well as along the whole line of interlacing currents.

This opinion is strengthened by the fact of the walrus having once resorted to this Island in great numbers, their tusks being frequently found imbedded in the sand.

That icebergs once followed the line of the polar currents past our shores there can be no doubt, even in this period.

By referring to Blunt's coast pilot, where pointing out the ice dangers of the coast, we find the following:

"In July, 1836, H. M. brig packet Express fell in with two islands of ice on Sable Island bank, lat. 43.03, long. 25.17, in 45 fathoms of water, estimated height 150 and 180 feet."

I would next call your attention to the wonderful similarity of those Banks and their limited amount of submergence, which suggests that many of them, if not all, have been elevated above the surface at no distant period in the past. We will consider the most interesting ones.

By glancing at this chart of relative submergence of off shore Banks, at the eastern extremity, we have the great Bank of Newfoundland, at the summit of which is a very dangerous shoal known as the Jessie Ryder, having only $3\frac{1}{4}$ fathoms or $19\frac{1}{2}$ feet.

At Quero bank, in lat. 44, long. 57, is a long narrow submerged ridge 40 miles in length, which in form and direction is an exact counterpart of Sable Island.

Next is the Sable Island Bank, 200 miles by 90, with a thin line of elevation, already alluded to, of 80 feet above the surface.

The next is one of great interest, viz., George's shoals, situated at George's bank, off the New England coast.

Capt. Hale, of the U. S. Navy, who surveyed this Bank, reported "That the breakers were such that unless the weather was perfectly calm it was impossible to go among the shoals with boats on account of the heavy seas. Nor was it considered safe to attempt it with the vessel, for besides the danger of striking on a sand bar the vessel would be liable to be filled with the breakers. And had not the sea been perfectly smooth and at high water, he would not have been able to get where he found but 3 feet at low water. And further he had no doubt but that this patch would be bare with a continuance of off shore winds."

This spit has an area of about one-third of Sable Island.

The breakers on those shoals are very heavy and can be heard and seen for a considerable distance.

It may be argued that this theory may account for the formation of this island, but not for its elevation above the surface.

In my last paper I referred to one of the most remarkable features in connection with this place, viz., the swirl-like current that surrounds it. A good illustration of this was given when, in February, 1803, the first superintendent having had three months of anxiety from the rapidity with which the island had been washed away in the vicinity of his house, and having lost much of his provisions by the depredations of rats, and fearing that want would stare him in the face before relief would reach him in the spring vessel, built a dispatch boat and sent her out crowded with sail before a S. E. gale in hopes she would reach the main land or be picked up by some in bound vessel that would carry the dispatches to the government, and acquaint them of the condition of affairs on the Island.

To his surprise, in 13 days after she returned to the beach, 6 miles above where she set out from.

Experiments are often made to test the strength of this current by throwing over a cask or barrel which will make circuit after circuit of the Island.

Bodies from wrecks also make the same circuit. It is quite customary for the surfmen to search on the opposite side for things which, in consequence of off shore winds, have been carried thither by the current and deposited upon the beach.

This swirl is no doubt caused by this third current, viz., the Gulf of St. Lawrence, augmented by that portion of the polar that sweeps through the Straits of Belle Isle, striking obliquely the other portion of the current in the vicinity of the island.

It is a well established fact that oblique currents have a tendency to form eddy or circular currents, and also that eddy currents of water pile up material carried along with it, as eddies of wind carrying snow build up all manner of fantastic drift.

In like manner this eddy or swirl current passing over a shoal so near the surface heavily charged with sand, on meeting with an obstacle, or even in its own vortex, would deposit the material held in suspension, thus forming a nucleus of the island. This shoal once reaching the surface and coming within sub-aeriel influences would hasten land making.

A beach once formed, the surface exposed at low water, would be dried and carried by the wind to a greater height, little by little hillocks or sand dunes would form. The waves would push forward the material on a long reach of bank near the surface, gradually the current would be crowded off shore, but still assisting to increase the area by depositing its material, which in turn would be dried and carried upwards by the wind. At last vegetation appearing the roots would anchor the summit.

Thus the process of land making would go forward so long as currents were favorable.

We have a remarkable instance of this in the formation of what has been called the new island off the east-end light.

An old wreck formed the nucleus around which the current piled its material, until a shoal formed, which gradually reached the surface and formed a small island.

At length grass seeds borne from the main island took root, anchored its summit and hastened its up-building.

This little island forming was watched with great interest by the surfmen, who entertained the hopes of its attaining such dimensions as would afford slight shelter, if only for a moment, when passing in the life-boat to a wreck on the N. E. bar. But the current that eddied around it became changed or weakened; it being left to the attacks of wind and wave and perhaps an

adverse current, melted away. A channel now marks the place it once occupied.

As in the case of this small island land building reached its culmination and declined. So in the case of the main island. Brought into existence by the current its maintenance would depend upon the favorable condition of the current.

But when the great Bank of Newfoundland reached such dimensions that it interrupted and divided the polar current, sending one portion southward, the other on its western way, as a reduced and sluggish stream, the effect becomes at once visible. All the western eddies or currents would be altered, the swirl that so aided in the formation of the island so weakened that during storms it would be converted into a confused erratic current, which, gnawing at the foot of the embankment, would topple great masses of its sand cliffs into the waves, as recorded from time to time by eye-witnesses. In this manner the forces that called this island into existence may now, under changed conditions, be hastening its destruction.

The first theory then is one supported by actual observation, and may be a prominent one in future investigations.

I now turn to the second theory, which has for its subject the result of those great forces exhibited during the ice age or glacial period.

That such a period did exist is beyond all controversy, although the condition of that period is still a matter of dispute among geologists.

I will epitomize two of the most popular theories: 1st, that of Lyell, Dawson and others, who suppose a general subsidence took place bringing down each part of the land successively to the level of the water.

Large islands and bergs of floating ice came from the north which, as they grounded on the coast or on shoals, pushed along all loose material of sand and gravel and broke off all angular and projecting points of rocks and where fragments of hard stone were frozen into the lower surface scooped out grooves into the sub-adjacent solid strata.

After the surface of the rocks had been smoothed and grated

upon by the passage of innumerable icebergs, the clay, sand and gravel of the drift were deposited and occasionally the fragments of rock, both large and small, that had been frozen into the glacier or taken up by current ice, were strewn at random over the bottom of the ocean wherever they happened to be detached from the frozen ice.

Finally a period of re-elevation, or that intermittent upward movement in which the old coast lines were excavated and the ancient sand bars laid down.

This process continued for an unlimited period, which has been considered to be quite sufficient to account for all the phenomena observed.

The second theory is one advanced by Agassiz and adopted by a large majority of geologists who have interpreted the glacial period as being one in which those forces acted on a much grander scale, which has been so graphically described by Dana, Belt and others. As a time when from the then elevated frozen regions of the Arctic an enormous ice-cap or glacier estimated to be from 4,000 to 6,000 feet in depth was forging its way southward across the northern portion of this continent with terrible abrading power, scooping out valleys, wearing the softer rocks into clay, tearing asunder the harder crags, grinding and polishing and grooving the sub-adjacent rocks, pushing before it and incorporating with itself great masses of rock, sand and gravel taken from the mountains over which it passed. At length it reached its culmination. The summit of Mount Washington stood out as a lonely island in a frozen sea, while to the north the whole continent was covered, not a single peak rising above the universal pall.

Another period was ushered in by a milder climate known as the Champlain period. The glacier melted at first with extreme slowness, but when thawed down to about 500 or 1,000 feet to where the gravel and stone were, it went forward rapidly and then took place a pell-mell dumping of this material over hill and valley, forming what is known as the glacial drift, of which the islands of our harbor are formed.

At last, owing to the rapidity of the final melting, an immense

flood took place, which swept away the finer portion of the material and sand to a lower level or seaward, leaving those perched rocks so frequently met with on hillsides and in valleys.

Everywhere beneath our feet on this peninsula of Halifax where the bed rock is exposed are the deep groovings which attest to the powerful pressure it has been subjected to.

From the labors of Dr. Honeyman, to whom this Institute is so much indebted for the geological problems wrought out by him in illustrating from time to time this drift period, tracing its boulders to their parent source, and by a train of evidence so strongly marked as to leave no doubt as to the distance and direction of their transportation, we learn something of the erosion our province has undergone while participating in this great ice period.

The retreat or melting of the glacier was followed by a re-elevation of the land *en masse*, bringing above the surface an immense deposit of material known as the Champlain sands.

As far as ascertained in the geology of our province the Champlain sands are wanting. Where shall we seek for the immense amount of finer material which must have been produced in this erosion? The conclusion is obvious. The striation on our rock surfaces all point to those off shore banks lying at right angles to the glacier.

Is this deposit too great? Listen to the evidence of Sir Roger Murchieson, one of England's greatest geologists, who, in speaking of the abrading effects of the ice period in which the British islands also participated, says:

"In the silurian formation of those islands alone there is a mass of rock worn from the land which would form a mountain chain of 1800 miles in length, with a breadth of 33 miles, and an average height of 16,000 feet."

This implies a vast amount of finer deposit, and also gives us an idea of the changes that must have occurred in the topography of our province.

In this Dominion, according to Sir Wm. Logan, there is in the triangle formed by Montreal, Champlain and Quebec, an area of 9,000 square miles of the Champlain sands and clays, containing few boulders, and carrying grains of magnetic iron and garnets.

Before us this evening we have a fair sample of sand taken from Sable Island. The cor-relation of this material with that of Sir Wm. Logan's is very striking. There are few or no boulders found on the Island. The sands are siliceous and carry magnetite and garnets, in every way equivalent to the Champlain sands.

This deposit at Montreal has an elevation of 500 feet, and may be traced in a continuous line 400 miles to Nantucket, where it merges into the off shore deposit.

It is evident we cannot hesitate in referring those sands to the same origin.

It would be idle to speculate on the probability of this whole off shore deposit which the currents have moulded and detached, being once above the surface.

Yet, I think this re-elevation that took place at the close of the Champlain period that uplifted those sands 500 feet at Montreal and gave Sable Island such an elevation that at this later period after its being for ages exposed to the ravages of the waves of the broad Atlantic so much is yet visible, would be quite adequate to uplift the whole embankment and form a sand continent equal in extent to the combined area of Nova Scotia and Newfoundland.

At the opening of this, or what is known as the modern period, we have entered upon another downward movement, a gradual subsidence being now in progress over the whole northern part of this continent, of which there is ample proof.

By observations at Nantucket and other points along the eastern seaboard, the subsidence has been 30 feet. The inundations that have of late so perplexed the railway people and farmers along the New Jersey coast attest to this change of level. In our own province we have the evidence given by the submerged forest at Bay Verte and other places in the Bay of Fundy; also the difficulties of keeping up the dykes at Grand Pre, owing to, as the farmers say, the tides rising higher than formerly, and the fact of hundreds of acres of grass lands being given up to the sea from the same cause, no later than last winter at Horton.

A few months ago, in company with Mr. John Woodworth, of Grand Pre, I traversed the shelving beach off Long Island, which is bared at low water for ¾ of a mile. From the channel to the shore we traced stumps and roots of forest trees, some of which would be covered at high water to a depth of 45 feet. Now, startling as this may appear to many, it is strictly in accordance with the geological changes that have taken place in all past ages.

This rising and falling of the bosom of mother earth tells of life within.

Sometimes she heaves a sigh and we record an earthquake. And when those movements cease and she assumes the condition of a dead planet, as the moon is thought to be, we, her children, will also cease to live. But I digress.

This off shore accumulation, having partaken of the upward movement at the close of the Champlain period, would also in sympathy with the coast partake of the subsidence now in progress.

This, aided by the leveling effect of waves and currents, would soon reduce it to the condition we now find it, with its summit alone above the water.

The rapidity with which it has reached its present condition can be judged by the changes that have occurred in the outline and area of this island since its discovery, to some of which I will turn your attention.

It is evident from the familiar manner in which those early navigators resorted to this place, it had a much greater area and importance without the dangerous surroundings it has to-day.

In 1560 Baron de Leroy arrived on the coast and finding it too late to get his colony under cover before winter would overtake him decides on returning, but first placing his cattle on Sable Island and sails thither. In 1598 Marquis De la Roche reached Cape Breton with his convict colonists, and fearing they would escape if left on the mainland prefers trying Sable Island and heads his vessel accordingly.

Five years after the King of France sends for De la Roche's pilot and orders him to proceed to Sable Island and bring back the convicts.

In subsequent years companies were formed in Boston and elsewhere for the purpose of hunting wild cattle on this island for their hides.

One of the party reports having seen over 800 head of cattle and many foxes, some of which were black. Unfortunately we have no dates from which to arrive at its former size, except that furnished by loss of area since the establishment of the government life saving station, during which time (85 years) it has been reduced to one-half its extent.

This is independent of charts and surveys which some have thought may not have been reliable, but such changes as necessitated the removal of buildings, light-house, etc.

I am not at liberty to assert that the present rate of deundation has been in force ever since those early voyagers visited the island. Nevertheless, after careful consideration and allowing for periods of comparative repose it may have enjoyed, I think I am warranted in placing the dimensions of this island at the time of its occupancy by the French convicts at least equal to an area of 80 miles in length, 10 miles in breadth, and a height not less than 300 feet, with an extensive harbor, having a northern entrance and a safe approaeh.

I do not believe an island of smaller extent so situated and surrounded by the same influence would at the end of 280 years be above the breakers.

As late as 50 years ago it had a commodious harbor, to which fishing vessels on the banks would run for on approach of a storm.

During a gale in 1836 its entrance was closed, shuting in two American vessels, whose ribs are now buried in the sands.

Early English charts show an entrance on the north side, which, in consequence of the depth of water on this side, would render approach thereto quite safe.

At that time also the survey gave the elevation of the sand cliffs as 200 feet, which enabled vessels to make the harbor more readily. A shallow lagoon now exists in its stead, separated from the ocean by a narrow ridge of sand.

In order to show the ravages committed by storms and currents on this island I will enumerate a few instances.

In 1813, during a single gale, an area equal to 3 miles long and 40 feet wide was carried away. Within 4 years previous 4 miles of the west end disappeared. This necessitated the removal of the main station, which was then located at a distance of 3 miles below.

In 1820 this station was again moved 4 miles further east, the sea having encroached upon it. In 1833 there being but ½ a mile between it and the sea, it was again moved 4 miles further eastward. Once more the sea advanced, obliging them to abandon this station and erect new buildings at about the centre of the island.

At this time the late Hon. Joseph Howe visited this place as a commissioner.

On his return he made the startling report that by actual measurement in 30 years 11 miles of the west end disappeared.

In this excessive removal of sand cliffs, a bar was formed over which the seas broke before reaching the cliffs and thus lost their abrading force and gave the west end a short respite. But gradually the currents removed this bar or shoal and the seas began again to manifest their force.

In addition to this gradual work of erosion great areas were removed bodily.

During one gale in 1881 70 feet by ½ a mile departed. A month later 33 feet of the whole breadth of the island disappeared in a few hours; and the following gale 48 feet by ¼ of a mile was carried away bodily, causing a hasty removal of the light-house apparatus. The place where the light-house once stood has passed seaward.

I need not dwell further on this evidence of demolition, enough has been given to show the destructive character of the forces still in operation.

Therefore, in seeking for the origin of this interesting island, I think I am justified in referring it to the Champlain period, that period which lifted from the deep that vast agglomeration of detritus as if to testify to the destruction wrought in the former age by the glacier, that ponderous engine of nature that has so scoured and remodeled the face of this continent.

As to its probable submergence, if then this island and its submarine surroundings belong to the Champlain period, and those are Champlain sands, we are enabled to comprehend aright the many changes that have come to this sand island or sand embankment.

It is apparent that an island so constituted having no solid strata whereon to rest, even if not participating in the general subsidence this coast is now undergoing, exposed to the full force of the unbroken waves of the Atlantic, before whose power its sand cliffs melt away in a manner that must be seen to be understood, must and will soon disappear beneath the waters.